

*Geological Notes. By E. W. Claypole.**(Read before the American Philosophical Society, October 20th, 1882.)***A.** *On an Error in Identifying Two Distinct Beds of Iron Ore in Report G of the Geological Survey of Bradford County.*

In Report **G**, *Bradford and Tioga Counties*, and on page 36, occurs the following passage :

“6. In Leroy township, about a mile and a half west of Leroy, in the main road, near the house of J. Wilcox, we found a bed of iron ore which appeared to be three or four feet thick, and of very good quality. See the following partial analysis by Mr. McCreath :

Iron	29.5
Sulphur.....	trace
Phosphorus204
Insol. residue.....	49.27

“7. The *same* bed is exposed at Leroy village, in Gulf brook, where it is nearly four feet thick and of good quality. A partial analysis of this ore by Mr. McCreath resulted as follows, though it can hardly be a fair test, for the average percentage of iron must be greater :

Iron.....	20.7
Sulphur.....	trace
Phosphorus.....	.185
Lime.....	8.71
Magnesia.....	1.3
Insoluble residue.....	46.655 ”

In reference to this passage I was informed during a recent visit in Bradford county by Mr. A. T. Lilley, of Leroy, that he considered it entirely erroneous, and that these beds of ore so far from being one were separated by a very considerable thickness of rock. The arguments which he adduced appeared to me quite satisfactory, and we went out to examine the ground.

Antecedently, if the two samples of ore were fairly taken, the analyses induce suspicion : they differ so largely from each other ; the quantity of iron is half as large again in the former as it is in the latter. It seems improbable that a bed of ore should vary so much in so short a distance.

The plan of this part of the valley given in Fig. 1, page 535, will make this line of argument intelligible.

The lowest bed of iron ore occurs in the Gulf brook in connection with

a mass of red sandstones, forming what are called the Mansfield Red beds. These beds, with a solid sandstone, continue westward and may be easily traced. The sandstone forms the buttress of the hill, and the Mansfield Red beds form a terrace higher up the slope. The direction of the strike of these beds is about N. E. by E. and S. W. by W. ; but the flattening of the dip curves the outcrop line and throws the basset edge farther and farther from the road. In addition, higher beds continually pass across the road from south to north as one goes westward, the azimuth of the latter being slightly nearer the meridian than that of the former.

With the aid of Mr. Lilley, I traced the sandstone for about five hundred yards to the west from the mouth of the Gulf brook where the strata are vertical and found it gradually flattening down to a dip of about 45°. Leaving this bed I went across the outcrop of the strata southward, coming, of course, on newer and newer beds at every step. At the distance of about three-quarters of a mile from Leroy is a strong exposure of a hard red sandstone in thin beds covered with peculiar fucoidal marks. It forms a low ridge in the valley and crosses the road at a short distance farther on. The strike of this bed agrees with that of the others above mentioned, and the whole district is quite undisturbed by any dislocation. Following it for some distance, I left it and crossing the strike again to the southward, found a bed of green shale quite in the bottom of the valley, and immediately upon it a second bed of iron ore, very much like that at Gulf brook. It crops out in the road a little farther west, as mentioned in the extract from the volume **G**, given at the head of this note.

Beyond this bed of iron ore, which can be traced north of the road up the hill lie the highest beds of the Chemung group—the *Grammysia elliptica* bed, the *Productella* bed, and the Cap-rock—the last a thin shale full of crushed and unrecognizable fossils. Each bed is separated from the next by a considerable thickness of unfossiliferous shale.

It is therefore beyond a doubt that these two outcrops of ore mentioned in the extract from **G** given above, are not parts of the same bed, but belong to two different beds separated from one another by an interval of several, perhaps 250, feet.

If any further proof of this conclusion is desired it may be found near Franklindale. Reference to the map will show that the road forks about a mile west of the village.* The two branches again meet at the distance of half a mile east from the fork. By walking from the latter point along the south road the order of succession, from the Mansfield Red beds upwards, may be distinctly seen. In particular, the two seams of iron ore may be readily detected by the red ground and the red road formed by their destruction.

* The site of the village is wrongly given in the map in Report **G**. It should be where the four roads meet, about a mile east of the spot where it is marked. The two roads also should be drawn meeting each other again, as above mentioned.

B. *Note on the occurrence of *Holoptychius*, about 500 feet below the recognized top of the Chemung Group, in Bradford County.*

The base of the Catskill group has been assumed on palæontological grounds at the lowest stratum in which the remains of the great Ganoid fish *Holoptychius Americanus* have been found. Lithologically and stratigraphically this dividing horizon has been placed where the green fossiliferous shales of the Chemung are supplanted by red shales and sandstones, mostly without fossils. Sometimes these two principles of division give coincident, sometimes discordant, results. Often the fossil remains cannot be found, and almost as often the line between red and green material cannot be firmly drawn.

In Bradford county, however, these difficulties do not occur. The green rocks give place almost suddenly to the red ones, and the line between Chemung and Catskill is easily drawn on stratigraphical evidence. The red Catskill rocks also in many places abound in remains of fish near if not at their base, consequently the two lines of evidence converge to almost coincident results. The occurrence therefore of a well marked and unmistakable scale of *Holoptychius Americanus* considerably below the dividing plane is a fact worthy of some notice.

The scale in question is on the surface of a slab of green sandstone and was quarried out of the solid rock by Mr. Lilley, of Leroy, when getting stone for the foundation of a barn. Although I am unable at present to determine exactly the position of the sandstone, yet from the fact that it lies at a very small distance above the Mansfield Red bed with iron ore, it must be not far from four hundred feet below the base of the Catskill group, as recognized in this county.

In further proof of the occurrence of the above-named fossil in this horizon, I may add that while engaged with Mr. Lilley, in examining the evidence for the presence of the Catskill, north of Franklindale, Mr. L. picked up a loose slab of *green sandstone* showing on its surface three large scales of *Holoptychius*. The point where it was discovered is very near the horizon of the specimen first mentioned, the bed rock is very near the surface, little or no drift material is present, the slab is not rounded, and the Catskill rocks are on the other side of the valley of Towanda creek.

All this evidence concentrated, leads me to believe that this second specimen is of Chemung age and comes from the same horizon as the first.

C. *On a Mass of Catskill Rocks supposed to exist on the North Bank of Towanda Creek, near Franklin.*

Reference to the geological map of Bradford county will show a patch colored to represent the Catskill on the north bank of Towanda creek, in Franklin township. It measures about four miles in length by one in its

greatest breadth, and is apparently intended to represent a cap of that formation overlying the Chemung of the same township.

The existence of this cap of Catskill, or at least of a great part of it, is beset with numerous difficulties to one who is familiar with the ground, and during my recent visit in Bradford county I became strongly suspicious of the accuracy of the map. The following consideration was very weighty in this direction.

The Chemung rocks all along the north bank of Towanda creek dip to the south at angles varying from 90° to 15° . At Leroy, the former occurs, and east and west of Leroy the dip flattens down, but not regularly to the latter figure. The dip also flattens down as one recedes from the road and goes northward, but very gradually, so that at Leroy it does not disappear, and render the strata horizontal in less than a mile.

With this inclination of the beds and with the highest beds of the Chemung far out in the valley, probably in the west end of it on the south side of the Towanda creek, it seemed quite impossible that any such mass of the Catskill could occur capping them so near the road upon the north bank. The generalized section along the valley is given in Fig. 2, page 535.

When it is recollected that the total thickness of Chemung rocks between the top of the group at *a*, and the horizontal exposure at *b*, must be at least 1500 feet, and is probably more, the difficulty of realizing a cap of Catskill on the top of a hill only 200 or 300 feet high becomes obvious.

Aside, however, from all antecedent and theoretical considerations, it was desirable to obtain the evidence of actual observation, in order to ascertain the truth, and also, if possible, to detect the cause of the mistake, if mistake had been made. On the morning, therefore, of leaving Leroy, I obtained the assistance of Mr. A. T. Lilley, a gentleman well acquainted with the district and with its geology, and set out to investigate the ground.

Leaving Leroy by the Towanda road we first established the fact that lower and lower beds of the Chemung come continually out of the hillside and point out into the valley for several miles, throwing the Catskill farther and farther to the southward, and giving a constantly thickening mass of Chemung to be placed on the hill-top, before the summit of that group could be reached. Turning to the northward up a road about one mile east of West Franklin, we followed it for nearly half a mile, until we attained an altitude of about 150 feet or more above the valley. The whole country on both sides of the road was deeply covered with drift, and no bed-rock whatever was visible anywhere. Nor was a scrap of the red Catskill sandstone to be found lying loose on the ground. Not only is it perfectly certain that no Catskill exists in place along this road (which follows a small run), but it is equally certain that many hundred feet of Chemung rocks are missing, and must be added to the top of the hill before the base of the Catskill can be reached. Yet this road on the map is drawn

crossing a broad belt of Catskill at less than half a mile from the valley turnpike. This Catskill cap does not, therefore, extend so far west as the road in question marked xx on Fig. 3, page 535.

Continuing our search we reached the point *a*, where the old and new roads meet and, taking the former or northern one, we crossed to the point marked with a cross. Here is a bold exposure of the Mansfield Red sandstones standing with a dip of about 40° S. E. by S. This point is almost exactly on the place where, according to the above-quoted map, the edge of the cap of Catskill should lie. It is unnecessary to say that no such material is there present. Not only are all signs of Catskill absent, but the whole thickness of the Chemung above the Mansfield red beds must be put on before its presence is possible. Time at our command did not allow us to go back into the county through the woods to determine at what distance this high dip disappears and the Chemung beds flatten down to a level, but it is perfectly obvious that even if any Catskill at all is here present it must be of small dimensions, and must lie much further north than it is represented on the map. With a dip of 40° at the point and about 500 feet of Chemung rocks missing, the existence of any such Catskill cap is almost a physical impossibility.

I may add that the evidence, so far as the short time at my command allowed me to examine it on the spot, is strongly against the existence of any Catskill west or north of Franklindale.

It appeared certain that the wreckage of the Mansfield Red beds, which is strewn over the hill-side along this part of the road, had been mistaken for fragments of Catskill, the source of which was supposed to exist higher up the slope. To account for the extension of the color so far to the westward is less easy, because, as mentioned above, not a fragment can be found upon the road marked with a double cross and lying east of West Franklin.

D.—*On two small patches of Catskill represented near Leroy, on the map in Report G, of the 2d Geological Survey of Penna.*

In connection with what has been written above, I may remark that not a scrap of evidence can be found in favor of the existence of either of the two round patches of Catskill rock represented on the map, one at Leroy and the other about one mile to the westward. The place in which the former is marked is on Upper Chemung beds, of about the horizon of the Mansfield Reds (which may have led to the error), and **STANDING VERY NEARLY VERTICAL**. The place of the other is near or at where the red sandstone with fucoids (mentioned in an accompanying note), which lies between the Mansfield Red beds and the *Grammysia elliptica* bed, crosses the valley road. Hence, perhaps, this mistake. The beds here are undoubtedly Chemung, and more than 100 feet below the summit of the group.

If this confusion was the real cause of the error it is the more surprising

because the iron ore bed which overlies the red fucoidal bed has been (as shown in the note above alluded to) confounded with another, occurring several hundred feet lower down in the series. If the presence of Catskill rocks is quite impossible with 100 feet of the Chemung missing, it would be much farther from possible if 400 or 500 feet were missing, as supposed in the report on Bradford and Tioga counties, p. 36.

E.—*On the Equivalent of the Schoharie Grit of New York in Middle Pennsylvania.*

The evidence of a single species, however "characteristic" it may be of a stratum or group of strata in one place in favor of identifying that stratum or group with another at any considerable distance, must always be of little weight unless strongly corroborated by collateral evidence. Even a single species, however, may be allowed to possess considerable value, *if thus corroborated*. From this point of view the following note may possess interest:

The *Cauda-Galli* or *Schoharie* grits of New York overlie the Oriskany sandstone. Of the former, Prof. Hall wrote in 1867 (Pal. of N. Y., Vol. 4, p. 1):

"The *Cauda-Galli* grit is almost a non-fossiliferous rock; a few fragments of plant-like fossils and the peculiar surface-markings of the slaty laminae from which its name is derived, being the only objects resembling organic bodies which have fallen under my observation. A single specimen of *Platyceras*, similar to *P. tortuosum* of the Oriskany sandstone, has been found in this rock, * * * * It passes by almost imperceptible gradations to the Schoharie grit, which is marked by the presence of numerous fossils. The upper beds of the *Cauda Galli* grit, and also the lower beds of the Schoharie grit preserve those peculiar markings which have been termed *Fucoides Cauda-Galli* (*Spirophyton Cauda-Galli*)."

It thus appears that these two strata in New York form really one group within which no line of demarcation can be drawn. This group consists of unfossiliferous beds at the base, *Cauda-Galli* beds above them, and fossiliferous beds at the top.

The *Cauda-Galli* grit is, however, a stratum of very limited extent, considered lithologically. It does not occur in the western part of New York, but is well marked in the east and extends into New Jersey. It thickens toward the Hudson and reaches 50 or 60 feet in the Helderberg mountains.

The *Schoharie* grit is distributed over almost the same area as that of the *Cauda-Galli* grit, being specially well marked at Schoharie and in the Helderberg. Both strata doubtless owe their deposition to the same set of geological causes.

Neither of these *grits* occurs in Middle Pennsylvania in any spot which has fallen under my observation. The strata immediately overlying the Oriskany sandstone, in Perry and adjoining counties, consist of calcare-

Fig. 1. Plan of the Valley of Towanda Creek, near Leroy. — Upper Chemung & Catskill.

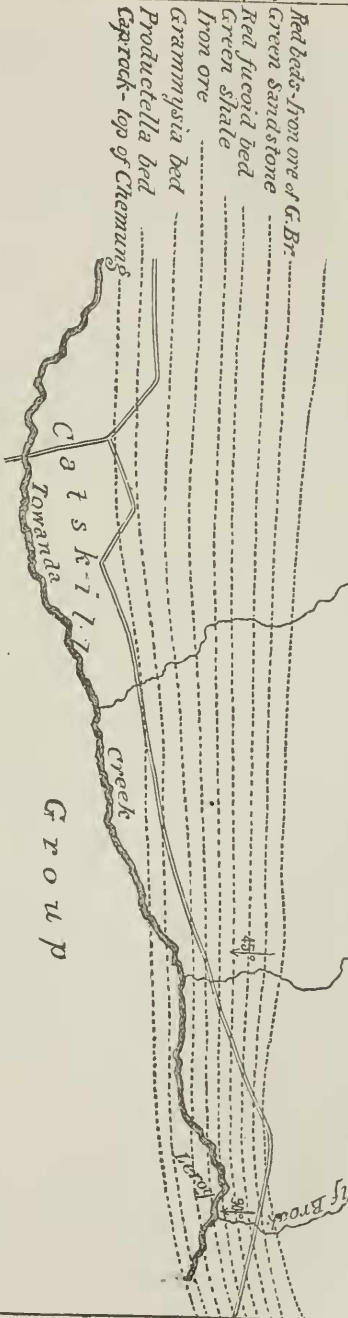


Fig. 2. General Section across the Valley of Towanda Creek, N. side, Chemung Group.

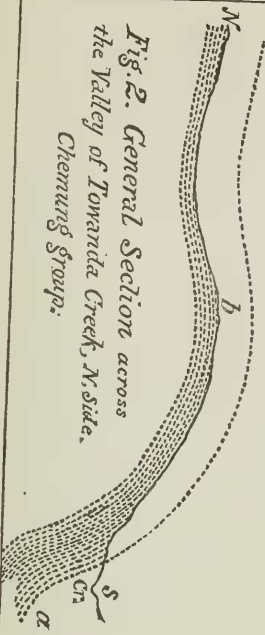
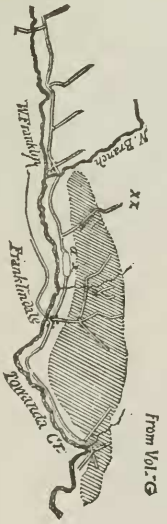


Fig. 3. The supposed outline of a Catskill outlier in Franklin T.



ous shales, argillaceous limestones and iron ores. For the most part the lowest of these is an impure, earthy, hæmatite or a very ferruginous shale. Apparently these two materials belong to the same bed, but appear differently at different places. Near Bloomfield it is a hæmatitic shale of no value, and yielding thus far no fossils except on its upper margin, where an undescribed *Beyrichia* occurs in great numbers. A few miles south of Bloomfield, in Sandy Hollow, it is a tolerably pure red ochre, much of which has been dug and ground for paint, but apparently the work has not yielded sufficient profit to lead to its continuance. Here also I have found no fossils, but have reason to think that some might be obtained if the exposure were larger. This ochre lies close against the Oriskany sandstone, here nearly vertical. At a short distance further south the same bed again yields red ochre, which has been dug out close to the Oriskany sandstone. The best layers for this purpose are the lowest, and these have thus far yielded me no fossils. But about ten feet higher up, where the beds are less ferruginous, I have met with abundance of specimens of *Atrypa impressa* Hall. They are well marked and in a good state of preservation, being little altered by compression. They also occur solely as internal casts.

Regarding this species Prof. Hall says (Pal. of N. Y., Vol. 4, p. 316): "This form of *Atrypa* occurs in the Schoharie grit. It is not known to me in any other geological formation." Also (p. 315), "The casts of the interior are more abundant than any other condition of the fossil in the Schoharie grit."

From the above facts the inference seems warranted that these two grits of Eastern New York or some parts of them are represented by the ferruginous shales above mentioned. The sandstones indicate a shore line for the time being extending, during the whole or part of the period, from Eastern New York through Northwestern New Jersey into Eastern Pennsylvania. But west of this there is no evidence of anything but open sea for a long distance, and the finer sediments accord with the conclusion. The same species, *Atrypa impressa*, which lived near the shore or was washed ashore when dead and was buried in the sandstone in New York, sank in Middle Pennsylvania into soft oozy shale and was there preserved.

What the conditions were which produced the deposition of marine iron ores and ochres it is impossible at present to say. We are too ignorant of the processes of marine metallic sedimentation to do more than guess at them—a useless expenditure of time and thought.